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MITES AND LICE ON POULTRY



THE CHICKEN MITE and various species of lice cause tremendous losses to the poultry raisers of the country. The fowl tick and sticktight flea are very serious poultry pests, but they are not so widespread in this country.

The common mite sucks blood from the fowls and breeds in the cracks of the roosts and buildings. Infested chicken houses may be completely freed of it by the construction of simplified roosts and one to three treatments with one of the carbolineums (high-grade anthracene oils) or crude petroleum.

Scaly leg is caused by a small mite which may be destroyed by dipping the feet and shanks of the fowls in crude petroleum.

Methods of eradicating the depluming mite and the destructive pest known as the feather mite are described.

Methods by which poultry lice may be eradicated by a single treatment with sodium fluoride are fully explained. This material has been found by the Department to be the most effective remedy against all poultry lice. If properly applied, it will not injure the fowls in any way, and its cost is but a fraction of a cent per bird. Since its introduction in 1917 it has become the standard louse remedy throughout the country.

MITES AND LICE ON POULTRY

By F. C. BISHOPP, *principal entomologist, in charge, Division of Insects Affecting Man and Animals*, and H. P. WOOD, *formerly entomological assistant, Bureau of Entomology and Plant Quarantine*

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EXTERNAL PARASITES are one of the most important factors operating to retard the development of the poultry industry, but it is difficult to determine which of the parasites are of greatest importance. Both lice and mites are found in practically every locality where poultry are raised. When present in any considerable numbers, both lice and mites reduce egg production and hinder the growth and reduce the quality of flesh of all classes of poultry.

MITES

THE CHICKEN MITE

Poultry raisers are all too familiar with the chicken mite (*Dermanyssus gallinae* (Deg.)), that common red or gray mite which infests poultry houses. In general those who are making a specialty of poultry raising have comparatively little trouble with mites, or at least they keep them reduced to a point where they are of little importance. On the other hand, farmers and others who raise poultry as an incident to other operations frequently find their chicken houses overrun by mites. The attack of this blood-sucking mite is of an insidious nature which does not readily draw attention to its presence, and often the poultryman is not aware of an infestation until he is attracted to it by the irritation produced by mites on his own body through coming in contact with the infested coops. The presence of the pest may be determined readily if small areas on the boards are specked with black and white as though dusted with salt and pepper. This is the excrement of the mites, which are hidden in adjacent cracks or rough places. More careful examination will reveal masses of mites in hiding, together with their eggs and the silvery skins cast by the young. In moderately infested poultry houses the injury to the fowls is not at once apparent, but the

constant blood loss and irritation are shown by decreased egg production and the poor condition of the fowls. In heavily infested coops it is not unusual for the chickens to become droopy and weak and have pale comb and wattles. Sitting hens desert their nests

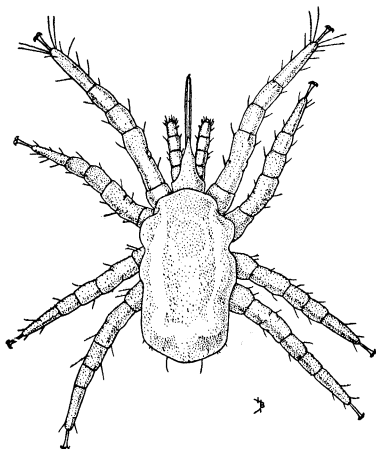


FIGURE 1.—First nymphal stage of the chicken mite, unfed. Greatly enlarged.

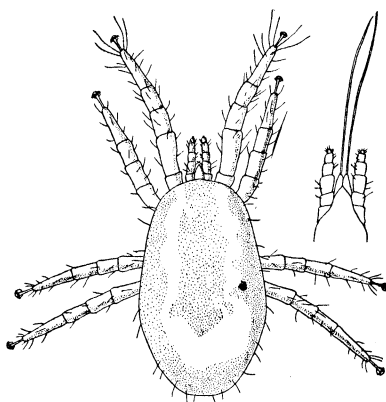


FIGURE 2.—Female chicken mite before feeding, greatly enlarged. Mouth parts at right more highly magnified.

and thus ruin the eggs or, as is often the case, they are found dead on the nest, being killed outright by the attack of thousands of mites. In extreme cases a considerable percentage of the fowls succumb, even though not sitting, and all are so weakened as to be very susceptible to various diseases.

DISTRIBUTION AND ABUNDANCE

Although the species sometimes becomes very numerous in the chicken houses in the northern part of the United States, the shorter breeding season there usually makes it of less importance than in the South, where breeding continues throughout the year with little or no interruption. Although many assert that dampness has much to do with the abundance of the chicken mite, experience has shown that the mite occurs in rather greater numbers in the semiarid and arid regions of the Southwest than in the more humid parts of the South.

LIFE HISTORY AND HABITS

Blood is absolutely essential for the development of this mite in all active stages. The mite feeds almost entirely at night except that it often feeds on hens on nests in the daytime.

Chickens may carry a few mites (sometimes a hundred or more) in their feathers during the day following a night spent in infested quarters, but most of these leave the host during the following night. In some cases mites may remain on chickens during 3 days and nights, but nearly all become engorged and leave them by the third night.

Within 12 to 48 hours after receiving a meal of blood the mature female deposits from 3 to 7 pearly white, elliptical eggs laid singly

in the cracks in which the adults are hiding. The operation of feeding and depositing is repeated as many as eight times, and from 25 to 35 eggs in all are deposited.

In summer the eggs hatch in about 2 days, and 1 to 2 days later, without feeding, the larvae shed their skins and become nymphs (fig. 1). With a very short rest these light-colored nymphs engorge with blood, secrete themselves, and molt their skins the second time 30 to 48 hours after having fed. These mites of the second nymphal stage soon engorge again, shedding their skins 1 to 2 days later and become adults. The grayish-colored unfed adult is shown in figure 2, and the engorged female, dark red in color and very plump, in figure 3.

Thus the chicken mite reproduces very rapidly, the complete life cycle from egg to adult requiring not more than 7 days.

The weather is never too hot for this mite to thrive, and development is most rapid in midsummer. In the Southern States the mites are not entirely dormant during the winter, but feed and develop when the temperature is not low. This is also true in the North in chicken houses that are heated. Where some development takes place throughout the year and a complete generation of mites is developed in a week's time, hordes of mites will be present in a poultry house within a comparatively short time if something is not done to destroy them.

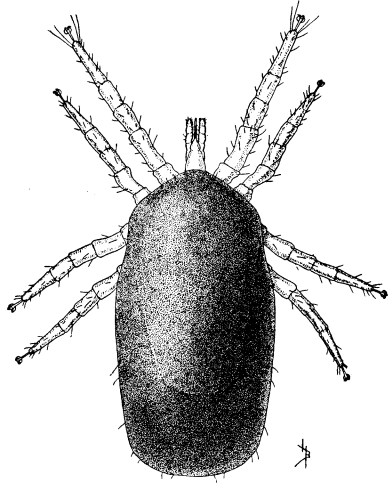


FIGURE 3.—Female chicken mite after feeding. Greatly enlarged.

LENGTH OF LIFE

It is probable that once a poultry house is infested, at least 4 months and probably 5 will have to elapse before all of the mites will starve if the chickens are removed from the house. In tests made by the writers some mites were still alive after a period of 113 days, and since these individuals were collected from an infested chicken house it is not unlikely that they had matured some time previously. The tests indicate that where the mites are supplied with a certain amount of moisture they will live longer than when kept under very dry conditions. This may account, in part at least, for the idea that mites are worse in damp and badly ventilated chicken houses.

HOSTS AND METHODS OF SPREAD

Chicken mites do not feed to any great extent upon other hosts when chickens are at hand. They are carried about chiefly by the interchange of poultry and in crates and boxes in which fowls are shipped. Clean premises sometimes are infested by mites carried on the clothing of people going from one chicken yard to another.

Pigeons also carry the mites, and sometimes their nests become heavily infested. The mites often crawl from these into houses and annoy people.

CONTROL

Owing to the fact that mites feed during the night and secrete themselves in cracks and crevices during the day, their presence very often is overlooked until a very heavy infestation has developed. In such cases they should be attacked energetically. Although they are not hard to kill, the greatest obstacle is the difficulty of reaching them in their hiding places. Dust baths will not control them, as at most only the few that remain on the chickens during the day will be destroyed.

The control measures described for mites are also applicable to the fowl tick¹ or "blue bug," and the bedbug, which often infests poultry houses.

TREATMENT OF INFESTED CHICKEN HOUSES

The first step necessary to destroy the mites is to get rid of the hiding places so far as possible. The roosts should be taken down and all unnecessary boards and boxes removed. In heavily infested houses the mites are to be found in all parts of the building, including the roof. Where they are less numerous the infestations usually are confined to the roosts and nests and the walls immediately adjacent. For small coops a hand atomizer will suffice for applying insecticides as sprays, but for larger houses a bucket pump, knapsack sprayer, or barrel pump is desirable. A rather coarse spray should be applied from all angles and thoroughly driven into the cracks. The floor also should be treated, as many mites fall to the floor when the roosts are being removed.

The carbolineums,² or high-grade anthracene oils, which are derived from coal tar, have proved very effective. The killing power of this material lasts for several months, and mites that may be inclined to come in from other buildings are repelled for a long time. The carbolineums usually cost more per gallon than other materials, but since the number of treatments necessary to control an infesta-

¹ For information on the fowl tick, see Farmers' Bulletin 1070.

² There are no standard Federal specifications for carbolineums, or anthracene oil. The material used in experimental work for the control of poultry pests was comparable with that conforming to specifications prepared by the American Wood Preservers' Association (Specification 24e) for anthracene oil. Material meeting these specifications should be obtained to assure satisfactory control of mites, ticks, and insect pests of poultry against which the carbolineums, or anthracene oils, are indicated to be of value. Specification 24e of the American Wood Preservers' Association reads as follows:

"ANTHRACENE OIL

"1. The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:

"2. It shall be fluid at 15° C., and shall remain crystal-free at 38° C.

"3. The specific gravity of the oil at 38° C., compared with water at 15.5° C., shall not be less than 1.09 nor more than 1.13.

"4. It shall not contain more than 0.5 percent of water.

"5. It shall not contain more than 0.5 percent of matter insoluble in benzol.

"6. The distillate, based on water-free oil, shall be within the following limits:

Up to 235° C., not more than 1.5 percent.

Up to 300° C., not more than 16.5 percent.

Up to 355° C., not less than 45 percent.

"7. The residue above 355° C., if it exceeds 40 percent shall have a float test of not more than 50 seconds at 70° C.

"8. The oil shall yield not more than 2 percent coke residue.

"9. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association (See Manual-Creosote, Analysis)."

tion of mites completely is fewer than when any other known material is used, their application is strongly advised.

Another coal-tar product, known as creosote oil, is also very effective against mites. It is cheaper than anthracene oil and is available in most cities.

Crude petroleum, although not so effective as the carbolineums, retains its killing power for several weeks and in most localities is very cheap. Since it does not dry into the wood so rapidly it is more likely to soil the fowls and clothing. Both the carbolineums and crude oil can be sprayed better if reduced with kerosene at the rate of about 1 part of kerosene to 3 parts of the other materials. Both of them often contain foreign particles which should be strained out before the spraying is begun. It has been found that one thorough application of either of the foregoing materials will often completely eradicate the mites from an infested chicken house, but ordinarily it is advisable to make a second application a month after the first, and in some cases a third treatment is required. These subsequent applications may be made with a brush, the materials being used pure, only the roosts, their supports, the walls adjoining, and the nests if they are infested, being covered. This method of application is effective for the first treatment also if the houses are not heavily infested. Poultry should be kept out of the treated buildings until the material is well dried into the wood.

It is desirable to spray or paint chicken coops a few days before putting broods of young chicks into them.

In spraying hen houses care should be exercised to prevent the spray from striking chickens around the building. This is especially important with young chicks.

Pure kerosene and kerosene emulsion in double the strength ordinarily applied to plants will destroy all mites hit, but these substances have not body enough to destroy those mites which are in more protected situations, and several applications at 10-day intervals are needed to destroy all the mites.

Arsenical dip, such as is used to destroy cattle ticks, has been found fairly satisfactory for use against chicken mites. Several applications are required to eradicate the mites from poultry houses. In regions where cattle dipping is practiced and this solution is readily available, it is perhaps the most convenient and cheapest material to use. Of course, due care should be taken to avoid the accidental poisoning of the fowls. The standard coal-tar stock dips, used in solutions slightly stronger than are recommended on the cans, will destroy all mites reached by the spray, and, in addition, their germ-destroying properties are a desirable feature.

In tests made by the writers lime-sulfur solutions such as are used against scale insects proved much less effective than the insecticides already mentioned. Standard indoor whitewash³ with 5 percent of crude carbolic acid or cresol added gives good results, although not equal to those obtained by the use of crude oil or the wood preservers mentioned. Dry sulfur or lime will not control this mite.

With any insecticide the results will depend largely on the thoroughness of the application.

³ Methods of making whitewashes are discussed in Farmers' Bulletin 1452 of the Department of Agriculture.

ROOSTS AND NESTS

After the first spraying it is advisable to put in new roosts if the old ones furnish many hiding places for mites. The roosts should never be nailed to the side of the building but arranged so as to be easily removable. A convenient form of roost is shown in figure 4.

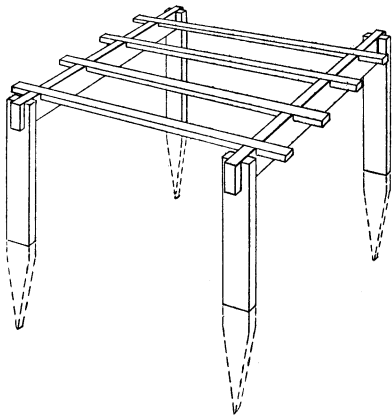


FIGURE 4.—Chicken roost, suggesting method of making treatment for mites easy.

The supports for the roost poles should consist of two 2 by 4's on edge in a horizontal position. The ends of these rest in notches cut in the ends of four uprights made of 2 by 6's and driven into the ground, nailed to the floor, or set in concrete. The roosts should consist of smooth 1 by 3's or 2 by 2's, the ends resting in notches cut in the 2 by 4's. If the notches fit the poles closely, it is unnecessary to nail the latter. The roosts thus are removed easily when the chicken house is to be cleaned, and a coat of one of the mite destroyers mentioned can be applied to the ends of the roosts occasionally. If dropping boards are used, they can be made to fit up to the four posts.

In larger houses the horizontal 2 by 4's may be fastened to the back wall with hooks or certain types of screen hangers.

Another method of constructing the roosts, which is especially applicable to the Southwestern States where the chicken tick occurs, is to suspend a frame from the ceiling on baling wire and place the roosts across this frame. None of the structure should be allowed to come in contact with the walls, and there is then little opportunity for mites to reach the chickens. The underside of the roosts must be watched, however, to see that mites have not been introduced accidentally, as they have been known to breed on such roosts until present in considerable numbers.

If it is convenient, the nests should be entirely apart from the roosting quarters. They may consist of boxes, which are easily handled, cleaned, or, if infested, destroyed. A series of nests made of boards is not objectionable if placed on a framework free from the walls of the henhouse and easily removable for cleaning. The simple arrangement devised by Professor Herrick, illustrated in figure 5, may be used. Wooden or iron brackets (*a*) are fastened to the wall and upon these are laid a 12-inch and a 6-inch board, the latter behind (*b*). These form the bottom of the nest and a shelf for the fowls to stand on in entering the nests. The back of the nests is formed by the wall, and the partitions are made by cutting a 12-inch board into pieces 12 inches long (*c*) held upright by a 1 by 3 (*e*) nailed on top even with the back edges and a similar strip (*d*) nailed along the front at the bottom. The partitions and the bottom can be readily lifted off and thoroughly cleaned and the wall behind treated. Usually it is advisable to hinge to the wall a sheet of corrugated iron in such a way as to form a slanting roof

over the nests to give seclusion and prevent fowls from roosting on them.

Great care should be taken to keep nests occupied by sitting hens free from mites. It is hard to work effectively against the mites when many hens are brooding; moreover, oil used freely about the house at any time may soil the eggs and prevent successful hatching. Infested quarters, therefore, should be treated thoroughly in the late winter before hens are set, so as to start them in nests which are absolutely clean. Beneath the straw of the nest a layer of lime and sulfur will tend to prevent mite breeding, and the entire nest may be dusted occasionally with pyrethrum. Broken eggs and the straw soiled by them should be removed promptly, as they tend to attract mites.

In case an infestation of mites is discovered in nests where hens are sitting it is advised that the corners and cracks of new nest boxes be painted with one of the carbolineums, after which the hens should be supplied with new nest material and the eggs and hens transferred during the daytime. The old nests should be burned or well sprayed.

When poultry are to be transferred to new quarters it is desirable that they be kept 3 days and nights in a pen so that the mites will leave them before their introduction into the new building. The roosts in the new building and in the quarantine cage should be treated in order that any mites which have left the fowls may be destroyed.

THE FEATHER MITE

Infestations of poultry flocks with the feather mite (*Liponyssus sylviarum* (Can. and Franz)) frequently occur in different parts of the United States. The source of the mites on the fowls has not been determined with certainty, but it is significant that the nests of English sparrows built in close proximity to some of the infested poultry yards have been found to harbor the mites. Infestations have also been noted from time to time on various other birds, including robins and swallows.

The general appearance of this mite is very similar to that of the common chicken mite, but it differs essentially in its breeding habits. Normally the mites remain on the fowls continuously, the eggs being deposited and hatching among the feathers where the young mites may complete their entire development without leaving the host. These mites are to be found in greatest numbers below the vent, about the tail, and sometimes on the neck. In these regions the feathers often exhibit a dirty appearance from the presence of the mites (fig. 6), and the skin is sometimes quite scabby owing to the irritation produced by their blood-sucking habits.

The fact that this mite breeds in the feathers of the fowls and often multiplies excessively makes it an important pest once it is established.

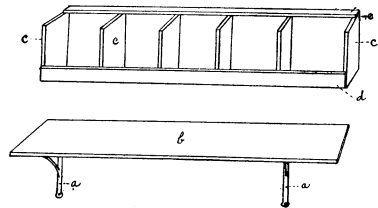


FIGURE 5.—Simple nest boxes. (After Herrick, with modifications.)

METHODS OF CONTROL

It will be seen from the description of this mite that it cannot be successfully combated with the same methods prescribed for the common chicken mite. It has been found, however, that an infestation

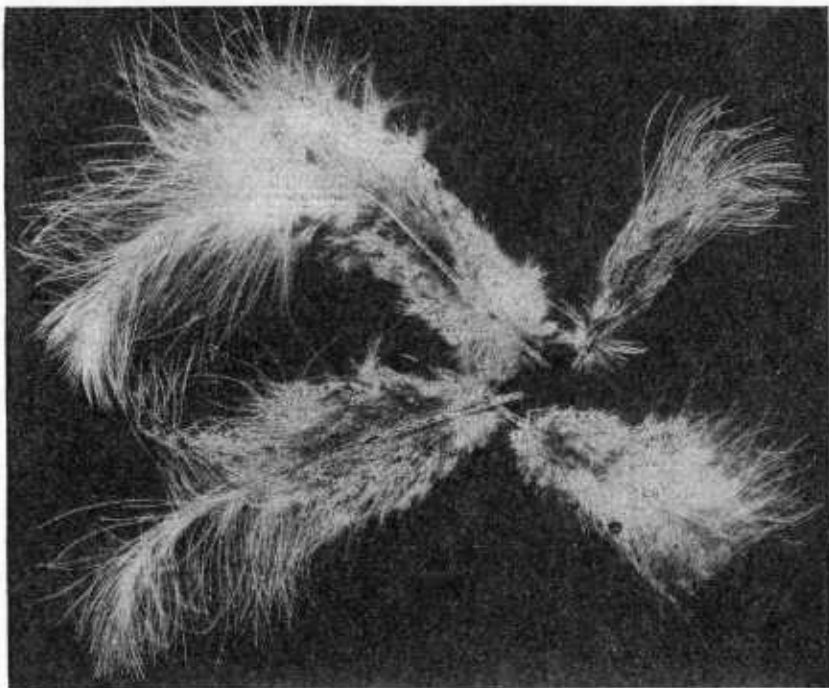


FIGURE 6.—Hen's feathers infested with the feather mite.

may be completely eradicated by the following treatment: If weather conditions are favorable, dip every well-feathered fowl in a tub containing a solution of—

Water	gallon..	1
Flowers of sulfur, or finely ground sulfur (93 percent passing a 325-mesh sieve)	ounces--	2
Soap	ounce--	1

The feathers should be thoroughly wet to the skin. The head should be submerged for an instant. During the dipping process the mixture should be stirred so as to keep the sulfur in suspension. Since the fowls are thoroughly drenched with this treatment, the dipping should be done only on warm, sunny days, or in a heated building. If treatment is found necessary during the winter or early spring months complete destruction of all the mites on the fowls may be accomplished by dusting them with flowers of sulfur, or finely ground sulfur (93 percent passing a 325-mesh sieve). The dusting should be thorough, the feathers being raised so as to insure getting the sulfur to the skin.

At the same time that the fowls are treated remove the nesting material and burn it and spray or paint the nest boxes, roosts, walls (even with the highest roosts), and floor of the chicken house with carbolineums as recommended for use against the common chicken mite. All nests of English sparrows which are accessible should be burned and attention given to the destruction of these nests throughout the spring.

Under favorable conditions, the application of nicotine sulfate to the perches about half an hour before the fowls go to roost will destroy all the mites on the birds, and two treatments at intervals of 2 weeks have been known to wipe out an infestation completely. To accomplish this the house must be fairly closely built but have adequate ventilation; all the birds must be on the perches; and the temperature should not be too low. This treatment is especially advantageous during the winter, when it would be dangerous to dip the fowls. The nicotine sulfate should be applied undiluted and should be of the strength commonly available on the market, a liquid which contains 40 percent of nicotine.

By following the measures outlined above, it has been found that this mite can be completely eradicated from premises.

SCALY-LEG MITE, DEPLUMING MITE, AND OTHER MITES

Two species of itch mites attack fowls, one of which (*Cnemidocoptes mutans* (Robin)) is the cause of scaly leg. Although this mite commonly remains on the feet, burrowing into the scales and causing their enlargement, it also attacks the comb and the neck. A crust of loose tissue is formed above the burrows, and intense itching results from this mining habit. When scaly leg is left untreated the feet often become badly distorted, and in some cases the fowl can scarcely walk or get up to the perch. Sometimes terminal joints of the toes are lost. As the mites are transferred from one bird to another, scaly-leg fowls should be treated promptly and should not be introduced among clean birds. Commercial carbolineums or crude petroleum used on the roosts doubtless will aid in preventing the spread of the scaly-leg mite from one fowl to another. Applying crude petroleum to the legs with a brush or dipping the legs into this oil (fig. 7) is very effective. One application usually is sufficient, but if the scales are not largely shed off after a lapse of 30 days the treatment may be repeated. Kerosene oil is applied by some farmers in the same way, but is less effective than crude oil. In using either, care should be taken not to get the oil on the upper part of the leg or on the feathers. A less severe but more laborious treatment consists of soaking the feet in warm soapsuds until the scales are loosened and then greasing the feet and legs with sulfur and lard, or lard containing 6 percent of crude carbolic acid.

The other itch mite (*Cnemidocoptes gallinae* (Railliet)), commonly called the depulming mite, is a very small creature which burrows into the skin near the base of the feathers. The intense itching sometimes causes the fowls to pull their feathers until they are almost naked. Dipping of all fowls of an infested flock in a tub of water containing about 2 ounces of flowers of sulfur or finely

ground sulfur (93 percent passing a 325-mesh sieve) and one-half ounce of laundry soap to each gallon of water will give complete control. The fowls should be completely submerged and the feathers ruffled as described in the dipping process with sodium



FIGURE 7.—Dipping the legs of a hen in crude petroleum to kill the scaly-leg mite.

fluoride. Care should be taken to keep the dip stirred during treatment so as to keep the sulfur in suspension. In case a flock has lice as well as the depluming mite, three-fourths ounce or one heaping tablespoonful of sodium fluoride may be added to each gallon of water in the foregoing mixture. Since soapy solutions thoroughly drench the fowls especial care should be taken to choose a warm day for the treatment.

There are two other species of small soft-bodied mites sometimes found on poultry. One of these (*Laminosioptes cysticola* (Vizioli)) bores into the skin. The other (*Cytoleichus nudus* (Vizioli)), which has been found in several places in this country, occurs in the air passages, lungs, liver, and other internal organs of chickens and turkeys. Serious injury probably is not caused by these mites except when they are present in large numbers, when breathing may be hindered. An-

other small mite (*Rivoltasia bifurcata* (Rivolta)) sometimes feeds on the feathers of fowls but causes no apparent injury. Still another species (*Freyana chanayi* Trouessart) has been found by the writers in great numbers along the grooves on the underside of the shaft of the wing feathers of turkeys in Texas and Louisiana. Associated with this, but apparently in very small numbers, another mite (*Megninia cubitalis* (Megnin)) was taken. Neither of these caused any apparent injury to the host. Several other kinds of mites are found on various birds, as well as on domestic fowls, but these are of little or no importance as parasites.

CHIGGERS (RED BUGS OR HARVEST MITES)

The chiggers (*Eutrombicula alfreddugèsi* (Oud.)) which attack chickens are the same minute red mites which attack man. They are the first stage of a large red mite which when mature is entirely harmless. Normally these immature mites are parasitic upon reptiles. They are often very widely distributed in fields and thus readily picked up by chickens. They attach themselves to the skin in groups beneath the wings and on the breast and neck. The injury is most severe among young chickens, although grown fowls occa-

sionally are annoyed to some extent. Young chickens which have a free range, especially if it extends into lowlands and under trees, are very susceptible to attack. The infested chickens become droopy and emaciated, soon refuse to eat, and if exposure to the mites is continued a considerable mortality is likely to result. Intense irritation is set up, and abscesses are formed at the points where the clusters of mites are feeding. These abscesses sometimes are one-third of an inch in diameter and surrounded by a greater inflamed area. Suppuration takes place beneath the skin, and swelling around the clusters of mites causes the formation of a considerable cavity at the center where the mites are attached.

In the South and in the Central States, where chiggers are numerous, probably the best plan is to keep young chickens from ranging during the summer where these mites are likely to occur. If chickens are hatched very early in the spring it is likely that they will escape chiggers more or less completely. When the chickens do become infested the application of sulfur ointment or kerosene and lard will destroy them. If extensive suppuration has taken place, the scab should be removed and the area washed with a 4-percent carbolic acid solution. Occasional light dusting of chickens with flowers of sulfur doubtless will keep these red bugs off, and where fenced range is infested the application of sulfur at the rate of 50 pounds per acre with a dust blower aids in keeping them under control.⁴

LICE

LICE ON CHICKENS

All poultry lice or bird lice have stout cutting or biting mouth parts which distinguish them from the sucking lice of cattle and other domestic animals. Unlike the mites, lice remain on the hosts constantly. More than 40 species of lice are found on the various domestic fowls. Some species are found on one host only, whereas other kinds may attack a number of fowls of different kinds. Chickens are infested by more kinds of lice than any other domestic fowl. Seven species are very commonly found on chickens in the United States, 4 or 5 on pigeons, 2 or 3 on geese and ducks, 3 on turkeys, and several each on guinea fowl and peafowl.

All these lice are adapted to the conditions under which they live. They have a flattened form and are fitted with various spines and peculiarly modified legs which assist them in moving about through the feathers. Certain species which remain on the larger feathers have a very narrow, elongate form which utilizes the protection afforded by the grooves between the barbs of the feathers. In fact, poultry lice show a wide divergence in size, shape, and spiny armature.

FOOD HABITS AND INJURIOUSNESS

Poultry lice are not fitted for sucking blood. They feed on portions of the feathers or on scales from the skin, and their presence in any considerable numbers is responsible for serious injury.

⁴ Further information regarding harvest mites or red bugs may be had from a mimeographed circular, E-281, Red Bugs, or Chiggers, and their Control, which may be obtained by applying to the U. S. Department of Agriculture, Washington, D. C.

In the Southern States the loss due to lice probably is greatest among young chickens. Chickens hatched after April 1 and brooded by hens experience a high mortality, much of which appears to be due directly or indirectly to lice. Early chickens also are sometimes affected. The lice often leave the hens and pass to the chickens before these become dry after emerging from the shell.

The first symptoms of lice infestation usually are droopiness, lowered wings, and ruffled feathers. Diarrhea follows, and the chickens then often die in a few days, or, when older, sometimes fall a prey to various diseases. Grown fowls sometimes may be very heavily infested with lice without showing any ill effects, but in such cases the egg yield is likely to decrease. In other cases the fowls may lose weight and sometimes die as a result of the lice or succumb to some of the common chicken maladies.

Turkeys suffer to a considerable extent when young, and no doubt poults frequently are killed by gross infestation. Older birds do not seem to be so badly affected. This is also true of ducks and geese. In general, these fowls are less heavily infested with lice than chickens.

KINDS OF LICE ON CHICKENS

The seven different species of lice common on hens are spoken of as body lice, head lice, and feather lice, according to the usual places in which they are found, but since the different species intermingle to a considerable extent, it is not possible to separate them absolutely on this basis. The writers have observed that the relative number of lice of the different species varies greatly in different flocks in the same neighborhood, and even in the same flock some chickens often have one species predominating, whereas others have another. Usually three or more species are to be found on an infested fowl.

THE HEAD LOUSE OF CHICKENS

This species (*Lipeurus heterographus* Nitzsch) is primarily a head louse, although occasionally found on the neck and elsewhere. It is undoubtedly the most injurious species to young chickens, as many of the other forms which are serious annoyers of grown poultry do not thrive well in the down on chicks. It is a dark grayish species nearly one-tenth of an inch in length, and may be found on the top or back of the head, behind the ears, or beneath the bill. Usually it is located close to the skin with its head very close to or against the skin of the chicken, the body extending away from the skin on the down or along the feathers. The eggs are deposited singly on the down or small feathers about the head. Eggs attached to a small feather are shown in figure 8. These hatch in 4 or 5 days into minute semitransparent lice which resemble the adult in shape. After molting the skin several times, and in the meantime increasing in size and becoming darker in color, the lice reach the adult stage in about 17 to 20 days. The male of this species is shown in figure 9.

Despite the fact that this louse confines its attack principally to the head, it passes readily from one chicken to another and from the mother to her young. This is the species against which the poultryman must guard his young chickens. The treatment recommended for various lice (pp. 18-25) is satisfactory for this species. It is

essential that the applications be made to the regions about the head to destroy this louse on grown fowls, and on young chickens this is the only region which requires attention. After young chickens are fairly well feathered the head louse decreases in number, probably

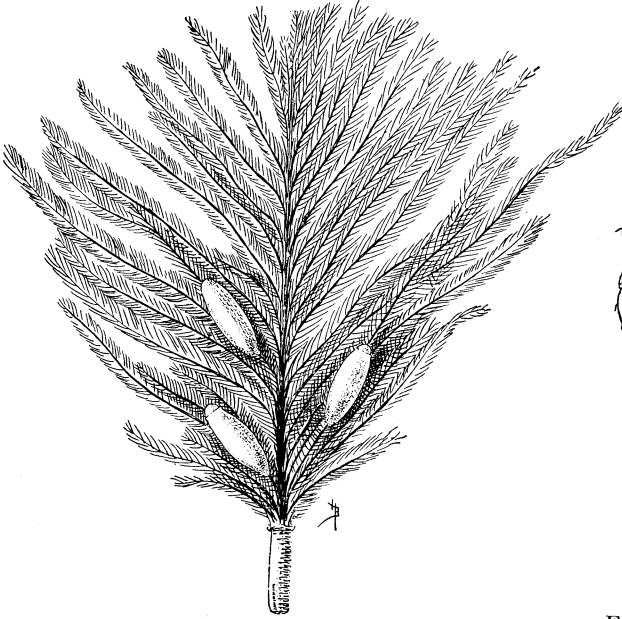


FIGURE 8.—Eggs of the head louse on feather.
Greatly enlarged.

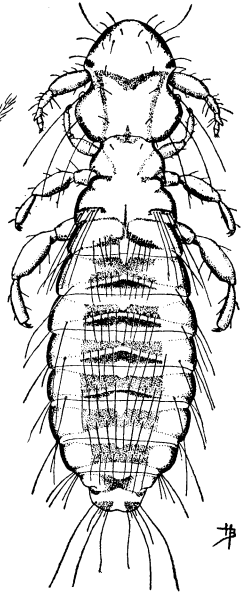


FIGURE 9.—Head louse:
Male, top view.
Greatly enlarged.

because conditions are less favorable for breeding and because the older chickens scratch the infested parts more vigorously. The number of head lice may increase again after the chickens become adult.

THE BODY LOUSE OF CHICKENS

The common name "body louse" is aptly applied to the species *Menacanthus stramineus* Nitzsch and refers to its habit of remaining on the skin of the fowl rather than on the feathers. It does not always confine itself to the body, sometimes being taken on the head, neck, and legs. It favors those portions of the skin which are not densely feathered. On chickens it is partial to the region just below the vent, but in heavy infestations it is abundant on the breast, under the wings, on the back, and also on the head, neck, and thighs. When the feathers are parted it is seen running rapidly upon the skin to seek protection. With young chickens it is more abundant on the back than around the vent.

This louse is rather large and robust and is straw yellow in color, with some dark spots due to food within the digestive tract. The two sexes are shown in figures 10 and 11.

The body louse is probably the most injurious species on grown fowls, but it also infests young chickens, sometimes seriously. As

it remains on the skin of the host, irritation is kept up constantly. Often a marked reddening of the skin of the fowl in the regions most heavily infested results, and and in some cases scabs and blood clots are formed.

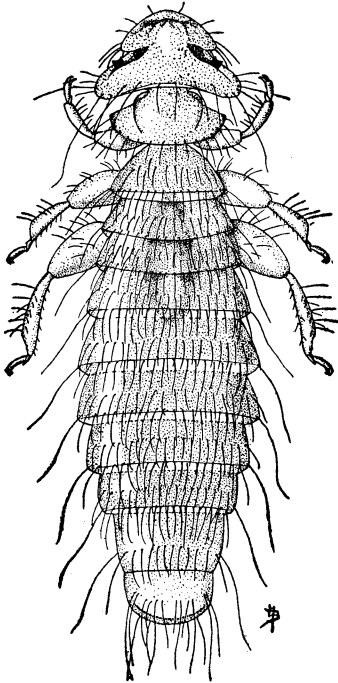


FIGURE 10.—Body louse: Male, top view. Greatly enlarged.

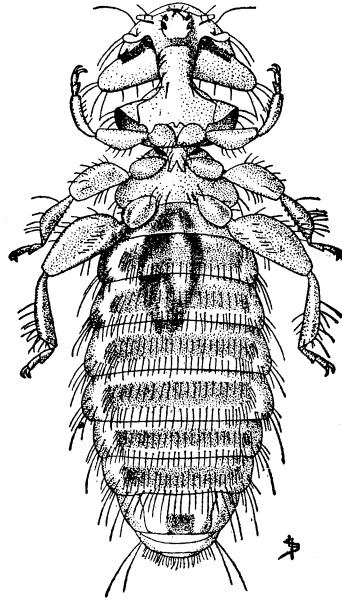


FIGURE 11.—Body louse: Female, underside. Greatly enlarged.

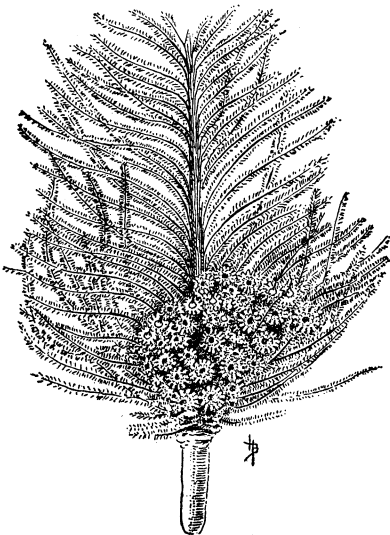


FIGURE 12.—Mass of body-lice eggs attached to feather.

The eggs are deposited in clusters on the base of the feathers, usually being attached to the lowest barbs along the shaft. They are most abundant on the small feathers below the vent, where the masses of eggs sometimes become very large—fully half an inch in length. As the lice continually deposit eggs, the masses are extremely large when seen several months after the fowls have molted. In young fowls the eggs are often deposited in numbers on down or small feathers and on hairs about the head and throat. A mass of eggs of this species is shown in figure 12.

The eggs hatch in about a week, and the adult stage is reached from 17 to 20 days after the eggs are deposited. This louse has a

short period of growth both in summer and in winter; hence fowls which are not actively fighting the lice become swarming with them in a very short time. Fortunately the heat of the body is necessary for the hatching of the eggs, and the lice themselves die in a very short time when off the fowl. For this reason little attention need be given to lice and eggs which are shed by the host during molting or at other times. This point, as well as methods of control, is discussed in later pages.

The body louse appears to pass readily from one fowl to another when they are closely associated. It also infests turkeys, upon which it multiplies to some extent, and it is said to occur on pigeons, but has not been found on them by the writers.

THE SHAFT LOUSE

The shaft louse (*Menopon gallinae* (L.)) is the species spoken of by most authors as the "small body louse," a name which does not fit the habits of the species. Normally, it occurs along the shaft of the feathers and does not remain on the body of the host for any length of time. The shaft louse is closely related to the large body louse and resembles it somewhat. It is smaller, rather lighter yellow in color, and somewhat less spiny (fig. 13). The habits of the shaft louse will enable one to separate it readily from the large body louse. When the feathers on the thighs or breast are parted this louse will be seen running toward the body along the shaft of the feather. Sometimes as many as a dozen lice will be seen, one behind another, along the feather shaft.

Although this species is probably the most common found on chickens in various parts of the country, the writers consider it of much less importance than the body louse, chiefly because it stays on the feathers the greater part of the time and probably feeds exclusively on the barbs of the feathers and on scales along the shaft. It is not known to occur on young chickens. Seemingly the absence of feathers prevents the successful development of the species on young fowls.

The eggs are deposited singly at the base of the feathers, hidden between the main shaft and the after shaft. It appears that eggs of the shaft louse require more time for incubation than those of the head louse or the body louse, and the time required to reach maturity is also greater. The shaft louse appears to live much longer on feathers that have dropped from the host than any other species on domestic fowls.

Several kinds of domestic fowls harbor the shaft louse, but it has not been shown that they will breed successfully on fowls other than the chicken. It has been found on the guinea fowl and on turkeys and ducks closely associated with chickens.

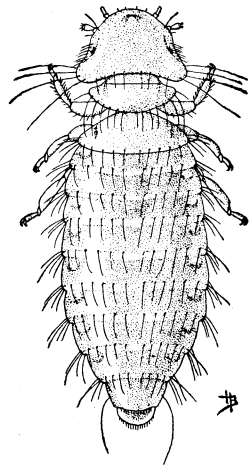


FIGURE 13.—Shaft louse: Female, top view. Greatly enlarged.

THE WING LOUSE

The wing louse (*Lipeurus caponis* (L.)) is the only species found commonly on the large wing feathers of chickens. It is seen at times also on the neck hackles, tail, and back feathers.

The wing louse, which is related to the head louse, is dark gray and has an elongate body. It is more slender than the head louse, however, and rather darker in color. Most easily seen on white fowls, it is found in all situations, but especially along the underside of the primary wing feathers. It is a sluggish species and often lies between the barbules of the feathers near the shaft without showing any life. The elongate white eggs are laid between the barbules of the large feathers.

OTHER LICE OF CHICKENS

Three other species of lice are found more or less commonly on chickens. The species to which the writers have applied the common name of "fluff louse" (*Goniocotes hologaster* Nitzsch) is very small

but broad, pale in color, with translucent appearance. It is common on fowls, but seldom abundant, and is of little importance. It is found on the fluff of the feathers on various parts of the bird, but is most abundant where the feathers are fluffiest. Usually it hangs to the loose barbs on these feathers some distance from the shaft and shows little activity.

The large chicken louse (*Goniocotes gigas* Tasch.) is less abundant than the fluff louse. When present, it is easily recognized by its very large size and striking appearance. It is nearly an eighth of an inch in length and very broad in proportion, as shown in figure 14. The color is smoky gray to almost black, with darker marks on the sides of the abdomen. It occurs on the feathers on various parts of the chicken's body and is remarkably agile for its size. Some call it the "blue bug"; hence it has become confused in certain

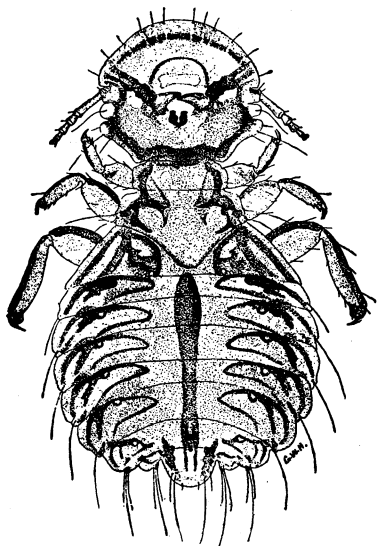


FIGURE 14.—Large chicken louse: Male, top view. Greatly enlarged (Herrick).

instances with the chicken tick, for which the name "blue bug" is generally used.

The brown chicken louse (*Goniodes dissimilis* Nitzsch) has been taken in several instances on chickens in Texas, Louisiana, Mississippi, and Florida. This indicates its presence in much of the South. It is somewhat smaller than the large hen louse and reddish brown in color. It is found on the feathers of the body. None of the three species last discussed has been taken by the authors on young chickens.

LICE ON TURKEYS

Four species of lice are commonly found on turkeys in the United States. One of these, which occurs particularly on turkeys associated with chickens, is the common body louse of chickens. The writers have not found this species in great numbers on turkeys, but it sometimes becomes sufficiently abundant to cause considerable irritation and doubtless is injurious both to the grown fowls and to the young. The shaft louse of chickens also has been found on turkeys, but probably does not breed on that host. The other two species seem to be native to the turkey, probably existing on this fowl in the wild state. The large turkey louse (*Goniodes meleagridis* (L.)) (fig. 15) probably is most abundant. It occurs on the feathers on various parts of the body, especially on the neck and breast. The slender turkey louse (*Lipeurus gallipavonis* Geoff.) is a species of good size, though rather elongate, resembling in shape the head louse of chickens. Normally neither of these species is excessively abundant, but on crippled or unthrifty turkeys they may cause serious annoyance and undoubtedly they are injurious to poults.

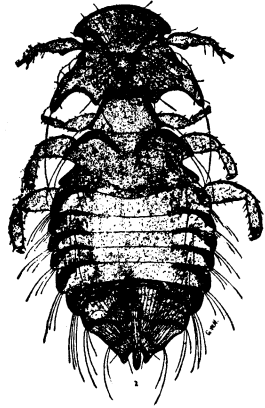


FIGURE 15.—Large turkey louse: Male, top view. Greatly enlarged (Herrick).

For remedial measures see the following pages.

LICE ON GEESE AND DUCKS

Although considerable numbers of lice are found on domestic geese and ducks, they seldom become sufficiently numerous to cause noticeable injury. One of these species (*Anatoecus dentatus* (Scopoli)) is common on ducks throughout the country, and a variety of this same species is to be found on the goose. A slender species (*Anaticola crassicornis* (Scopoli)) has been found by the writers rather commonly on the duck in the vicinity of Dallas, Tex., and in other parts of the United States. Another louse that is similar in form (*Lipeurus bishoppi* McGregor) has been collected on these hosts in Mississippi. Both these species inhabit the wing feathers and are often very numerous at the base of the large feathers of the wing. Young ducks that have been hatched by hens are sometimes much annoyed by the head louse, which attacks them in the same way as it does young chickens.

The same control measures recommended for chicken lice will destroy these insects on ducks and geese.

PIGEON LICE

Considerable annoyance to pigeons has been reported by poultrymen in different parts of the country. Although a number of species of lice have been reported as occurring on pigeons, most of the trouble seems to be due to the slender pigeon louse (*Columbicola columbae* (L.)) and the small pigeon louse (*Goniocotes bidentatus*

(Scopoli)). The former sometimes occurs in great numbers, attacking both the old birds and the partially feathered squabs.

For measures of control see the discussion of this subject in subsequent pages.

LICE ON GUINEA FOWL AND PEAFOWL

The guinea fowl and peafowl are both subject to the attack of several species of lice. Most of these are of kinds different from those found on the common chicken and other domestic fowls, but the guinea fowl has been found to become infested with four of the species which occur on the chicken. It does not appear that either of these hosts is materially injured by lice, but it is necessary to bear in mind the risk in allowing guinea fowl to remain untreated when eradicating lice from other poultry on the same farm.

CONTROL OF POULTRY LICE

It has been generally felt that poultry lice are more or less a necessary evil and that the best that can be expected is to keep them in control by repeated treatment. A few have attempted, with varying degrees of success, to start with clean premises and clean fowls and keep them free from vermin. This is most feasible in the case of persons going into the poultry business on a rather extensive scale and with entirely new equipment. (See p. 25.) For the average farmer and the poultryman already established the situation has resolved itself largely into a fight against the various pests already present.

There is no fundamental reason why a flock should not be entirely freed from lice and maintained in this condition. Reinfestation comes principally from stray fowls which gain access to the poultry yards and from purchased stock added to the flock. Stray fowls cannot always be excluded, but in the case of added stock it is advisable to treat all chickens, old or young, when they are first brought on the premises.

The time of year for starting a campaign against lice is another point to be considered. The writers would favor the treatment of the entire flock during the late summer or early fall. At this time of the year weather conditions usually are favorable for dipping, most of the young fowls are well matured, and much of the superfluous stock has been disposed of, so that there are fewer birds to treat. Since there is very little danger of reinfestation from lice on molted feathers, the question of avoiding the molting period is not a serious one; yet if the treatment can precede molting it probably would be better.

If the fall treatment has been neglected it is imperative that the flock be cleaned of lice before brooding time in the spring. Usually this would mean that the dusting method would have to be followed on account of adverse weather conditions. Treating the birds at this time will insure their vigor as well as undisturbed brooding, which is necessary to successful hatching, and, what is more important, the infestation of the young chickens will be avoided. Although lice normally stay upon the host continuously and do not have the habit of hiding away in cracks about buildings, yet the

poultry houses and runs should be well disinfected occasionally, especially as action against mites is necessary if these are present. It is well to make this general clean-up at the time the flock is treated for lice. This minimizes any danger of reinfestation.

On large poultry farms the complete eradication of lice is often complicated by inability to control the fowls. When proper pen construction is at hand, it is possible to treat a pen or two a day until the entire flock is covered. The more rapidly treatment progresses the better, of course, and great care should be taken to avoid the escape of fowls from infested to uninfested pens.

SODIUM FLUORIDE EFFECTIVE AGAINST ALL LICE

The writers have tested a number of the materials most generally advocated for lice destruction and several new compounds which it was thought might be effective. In this series of tests nothing else was found to be as satisfactory as sodium fluoride. The experiments have demonstrated that this chemical is exceedingly poisonous to all species of chicken lice. It kills both adults and young, including the young which emerge from the eggs present at the time of treatment.

Sodium fluoride can be obtained in two forms, known as commercial and as chemically pure. Both of these are in a dry state, the former being a dry powder and the latter consisting of small crystals somewhat lumpy. Although the chemically pure material is effective, it is not so easily applied by the dusting method as the more finely powdered commercial form, and furthermore, it is higher in price. The commercial grade should contain 90 to 98 percent of sodium fluoride.

When sodium fluoride is asked for at the store, the word "fluoride" should be distinctly pronounced, as this poisonous material might otherwise be confused with sodium chloride (common table salt). Up to the time this material was introduced as a louse remedy the demand was very limited. Prior to the work of the writers its only known insecticidal use was against cockroaches, for which it has been demonstrated to be very effective. At the present time sodium fluoride is sold by most dealers in poultry supplies as well as by druggists. The commercial sodium fluoride at present prices should be retailed at from 30 to 60 cents per pound, the price varying somewhat with the quantity ordered by the dealer and the distance from the chemical manufacturing centers. Sodium fluoride in a dry state does not deteriorate quickly. It should be kept in a dry place either in bottles with stoppers or in closely covered cans. In this condition it will remain active indefinitely.

METHODS OF APPLICATION

In treating poultry with sodium fluoride, if proper methods are followed, a remarkable degree of control is obtained. One application of sodium fluoride to all fowls on a given premises will completely destroy all lice present.⁵ It is essential to make sure that the

⁵ As an example of complete eradication, a flock of 150 Wyandottes treated by the owners at Raymond, Ill., in November 1917, was found, in April 1919, to be absolutely free of lice.

treatment is thorough and that every fowl is treated, for if one infested chicken escapes it will in a short time reinfest the entire flock and thus make it necessary to do the work over in a few months at a considerable loss of time and money.

Sodium fluoride may be applied in two forms—as a dust and as a dip. In using either form the first step is to see that all fowls are shut in the poultry house or placed in coops prior to beginning treatment.

DUSTING

The action of sodium fluoride when applied in dust form is comparatively slow; hence, if fowls are examined the day following treatment, or even 2 or 3 days later, some lice may be found. The material persists, however, and after 4 or 5 days all lice disappear. Apparently the hatching of the eggs is not prevented, but the young lice find sufficient material present in the feathers upon emerging from the eggs to destroy all of them.

For complete destruction of lice it is essential that small quantities of the material be placed on different parts of the infested birds. Contrary to the usual belief, all species of lice do not migrate freely from the one part of the bird to another; hence the material must be well distributed to bring it into contact with all the lice present.

The writers have found what they term the “pinch method” to be entirely effective against all lice, and to have the advantage of economy of time and material. When the material is applied by this method (see illustration on title page) it is placed on a table in an open vessel, and the fowl is held by the base of the wings with one hand, while with the other hand a small pinch of the chemical is placed among the feathers next to the skin about as follows: One pinch on the head, one on the neck, two on the back, one on the breast, one below the vent, one on the tail, one on each thigh, and one scattered on the underside of each wing when spread. Each pinch can be distributed somewhat by pushing the thumb and fingers among the feathers as the material is released. It is advisable when dusting to hold the chicken over a large shallow pan, as in this way the small quantity of material ordinarily lost is recovered.

The material may be applied by means of a shaker, but this method has some disadvantages as compared with the pinch method. Small nail holes are punched in the bottom of a can, which is provided with a close-fitting lid on the other end. The material is then shaken into the feathers with one hand, while the feathers are opened with the other. This necessitates the presence of a second person to hold and turn the fowl. When this method is followed the quantity of sodium fluoride used may be reduced by adding 2 parts of some finely powdered material, such as road dust or flour, to each part of the chemical. If the material is employed alone, somewhat more of it is used than by the pinch method, and more or less dust floats in the air, which causes irritation of the throat and nose. This can be avoided largely if the operators wear dust guards over the nose or keep pieces of wet cloth over the nose and mouth. As the fowls are dusted they should be released in the open to prevent possible injury to them from breathing the dust, which might occur if they were crowded in a building.

Although the writers have not applied this material with a dusting machine or revolving barrel, they are of the opinion that this would not be thorough, might bruise the fowl, and would be irritating to the air passages of the birds.

For lice on young chickens, young turkeys, and, in fact, all newly hatched fowls the application of sodium fluoride in the dust form is recommended, rather than dipping. This applies also to sick fowls.

Sodium fluoride if used too freely on very young chicks may kill them. The importance of treating the hen before the hatch comes off is urged. It has been found that there is no injury to eggs provided the sitting hen is properly treated. If this is not done the chicks should not be treated until about a week old and then only two very small pinches should be used. One of these should be distributed on the neck, top of head, and throat, and the other on the back and below the vent. The mother should be given only three pinches—one on the head and neck, one on the back, and one below the vent. The treatment should be given while the chicks are active, and for a time they should be prevented from hovering, so that the free powder will be shaken off.

The application of sodium fluoride to pigeons by the dust method, using about five pinches to each pigeon, has been found effective, but for complete eradication dipping should be practiced.

DIPPING

There seems to be a general sentiment among poultry raisers against the practice of dipping fowls. This is probably partially on account of the fact that the dips tried have been of an oily or caustic nature and have tended to soil the feathers and in some cases injure the skin of the fowl and give the feathers a thorough wetting. The experience of the writers does not justify this aversion if a sodium-fluoride solution is used. It may be said that in general dipping is most applicable in the Southern States and to summer treatments in the North. The first requisite is a rather warm, sunny day, so that the fowls will dry quickly. Dipping in windy weather should be avoided. In dipping fowls as described below, the feathers do not get thoroughly wet, and if the operation is finished an hour before sundown the fowls will become thoroughly dry before going to roost. In extensive tests of this method the writers have observed no ill effect whatever from the dipping. As compared with dusting, this method has an advantage in that it reduces considerably the cost of materials, is more rapidly done, and the discomfort of the operator is avoided. Dipping is just as effective as dusting.

The lice die much more quickly following dipping than when sodium fluoride is applied in dust form. It appears that all those touched by the liquid die very promptly and the others succumb in a few hours.

In dipping, all that is necessary is a supply of tepid water and a tub. If two persons are to dip at the same time it is advisable to use a large tub. The water should be measured into the tub and $\frac{3}{4}$ to 1 ounce of commercial sodium fluoride added to each gallon of water. The sodium fluoride is readily dissolved by stirring. The tub should be filled to within 6 or 8 inches of the top, and as the

quantity of solution is lowered through dipping numbers of fowls, water with the proper proportion of sodium fluoride dissolved in it should be added from time to time. In dipping the fowls it is best to hold the wings over the back with the left hand and quickly submerge the fowl in the solution, leaving the head out while the feathers are thoroughly ruffled with the other hand so as to allow the solution to penetrate to the skin on different parts of the bird. The head is then ducked once or twice, and the bird is lifted out of the bath and allowed to drain a few seconds and is then released.

It is not necessary to keep the fowl under the water longer than 20 to 30 seconds or the head more than an instant.

Owing to the fact that pigeons are so closely feathered it is necessary to add about $\frac{3}{4}$ to 1 ounce of laundry soap to each gallon of water in order to increase the penetration of the dip. A thorough dipping of the pigeons, including all squabs, in this way and ruffling the feathers while the birds are under the water will destroy all lice.

EFFECT OF SODIUM FLUORIDE ON FOWLS AND MAN

Fortunately this compound is very destructive to lice but does not produce any ill effects on the chickens, when used as recommended. No skin irritation or injury to the condition of the feathers has been observed in the large number of domestic fowls used in experimental work, when either the dusting or the dipping method was used. In fowls that are being dusted there is occasionally some temporary irritation of the air passages, as evidenced by labored breathing and sneezing. This effect is not noticeable a few minutes after treatment.

Caution is necessary to prevent the sodium fluoride when used in dust form from gaining access to the food and water of the fowls. Sodium fluoride solution should be emptied out where the chickens cannot drink it before it soaks into the ground. It should be remembered that the material is poisonous if taken internally.

Where some of the sodium fluoride in the dust form reaches the body of the operator and is allowed to remain for a number of hours, as may be the case when several hundred fowls are dusted, local irritation and burning may occur on tender portions of the skin. In dusting large flocks it is therefore advisable to do the work on a table rather than to hold the fowls between the knees, as is sometimes done. The solution does not injure the hands, even when the dipping is continued for a number of hours, except in cases where there are sores that may become slightly irritated.

Precaution should be taken not to allow sodium fluoride solution to remain in galvanized vessels any great length of time. In fact, it is best not to keep it overnight in tubs or galvanized containers, as it will injure them.

Caution.—Sodium fluoride is poisonous to man, hence it should not be left where it might be used by mistake in food or as medicine.

COST OF APPLICATION

One pound of commercial sodium fluoride, when applied by the pinch method, will treat approximately 100 hens; thus at a cost of 40 cents per pound the expense for material will average less than one-half cent per fowl. It has been found by actual practice in treating

several hundred fowls that an average of from 2 to 3 minutes is required for treating each fowl, one man doing the work. This includes the time necessary for catching the birds, as well as dusting them. The dusting itself occupies 1 to 2 minutes. Of course, the time involved in catching them would vary in every individual instance according to conditions. Using the above figures as a basis, and figuring a man's time at 30 cents per hour, it would cost approximately \$1.65 to treat 100 fowls by the pinch method.

When the shaker can is used the quantity of material is usually double and the average time per bird is somewhat increased.

By the dipping method the quantity of material is considerably reduced, especially if large flocks are to be treated at one time. Over 800 fowls have been dipped at one time, an average of 5.2 ounces of sodium fluoride to 100 fowls being used, which at the same figure would cost 13 cents. The labor involved is also thus reduced. The average time for catching and dipping the birds was about $1\frac{3}{4}$ minutes per fowl, one man working. This makes a cost of labor, as above computed, of about 87 cents per 100 fowls and a total cost for material and labor of about \$1. This reduces the cost so that it is within the reach of every one, especially when it is considered that ordinarily much time is occupied in fighting lice without accomplishing that complete destruction which would result from a single treatment as above outlined.

NICOTINE SULFATE APPLIED TO THE ROOSTS

During the last few years nicotine sulfate has been widely used against chicken lice. The material is applied to the entire upper surface of the perches with a brush about half an hour before the fowls go to roost. The fumes pass upward through the feathers and suffocate the lice, causing them to come to the surface and later to drop off and die. A large percentage of the lice are killed the first night after the treatment, a few the second, and still fewer the third. The eggs are not all destroyed, so a second application 8 to 10 days after the first is advised to destroy the newly hatched lice. The body louse, shaft louse, and fluff louse can be cleared out of a flock by two or three applications if all fowls are made to roost on the treated perches. Some head lice and wing lice are likely to escape being killed, so complete eradication of all lice from a flock cannot be accomplished as with sodium fluoride. The rapidity with which the treatment can be applied and the avoidance of handling each fowl commend the method to many poultry raisers.

There is no appreciable adverse effect on the fowls if the house is well ventilated.

OTHER REMEDIES FOR LICE

Sodium fluosilicate, a compound very similar to sodium fluoride, applied in the same manner as is the latter, gives very satisfactory control.

One application of flowers of sulfur when applied thoroughly in dust form has been found to destroy all stages of several species of lice experimented with. In a few instances, however, some lice remained on the fowls after treatment. This was attributed to the

difficulty of getting the dust over every portion of the fowl, but at the same time it shows that exceedingly thorough and careful application of sulfur is required to obtain complete destruction. About 4 days are required for the fowls to be freed of living lice. The ready availability of flowers of sulfur and its comparatively low cost per pound tend to recommend it for this use. Furthermore, it is not disagreeable to handle.

A number of poultry raisers, however, have stated that injury to the fowls sometimes results from the use of sulfur, although the writers have seen no injury further than a very slight scaling of the skin following treatment. It is possible that the injury observed by some was due to mixing the sulfur with grease or other substance. To accomplish complete destruction, the writers have found it necessary to use considerable quantities of sulfur, averaging about 6 pounds per hundred fowls, which at 10 cents per pound would make a cost of 60 cents for the material. The expense of application would be about one-half greater than that given for the use of sodium fluoride by the pinch method, as it is necessary to apply the sulfur with a dust can. The total expense would therefore be greater than that of using sodium fluoride by the pinch or the dipping method.

The writers have found also that dipping fowls in a soap solution made by dissolving 1 ounce of laundry soap in a gallon of water will destroy all lice present, but a second dipping 10 days later is necessary in order to destroy the lice that have hatched from eggs which were not killed by the treatment. This soap solution causes a complete wetting of the feathers, and hence there is some danger of producing colds when the weather is unfavorable. It should be used only during favorable weather.

A great number of remedies are in general use in the United States, only a few of which can be mentioned here. A mixture known as Cornell powder and consisting of crude carbolic acid, gasoline, and plaster of paris, is effective in reducing the number of lice, but experiments have shown that at least two, and perhaps more, applications are necessary to destroy all the lice.

Mercurial ointment, or blue ointment, has also been advised. It has been found that the use of this material as recommended will greatly reduce the number of body lice but that it has little effect on head and wing lice. When several times the quantity usually recommended is applied to a number of places on a fowl it is effective, but the cost of the material and treatment is greater than if sodium fluoride is used, the greasy material is objectionable, and burns result.

A number of other compounds, many of which contain pyrethrum, are advocated. These also fail to accomplish complete destruction of the lice. For head lice on young chickens carbolated petrolatum applied in small quantities has been found quite satisfactory. Medicated nest eggs, said to control poultry lice, are on the market. For the most part these consist largely of naphthalene. Although this material will destroy lice when applied generally to the fowl, it is markedly injurious to the hen's eggs as well as to the bird. If it is used in quantity, or if the medicated eggs are allowed to remain for a considerable length of time beneath a hen, she may die.

SUPPLEMENTAL CONTROL MEASURES FOR ALL PESTS

Chickens will not give adequate returns in eggs or growth when kept under insanitary conditions. The construction of the poultry house should receive first attention. Adequate air space, lighting, and ventilation should be provided, and the entire house should be cleaned out at frequent intervals. Although these things cannot be depended upon to control mites and lice, they aid the poultryman in determining when these pests are present, and furthermore, the fowls are kept in vigorous condition, which in itself is conducive to the control of various pests. Diseased fowls, or those with malformed bills or feet, fall ready prey to lice, mites, and other insect pests. The suggestions given on pages 6 and 7 for the construction of roosts and nest boxes should be followed, even though the buildings are new and otherwise properly arranged.

DUST BATHS

Although it may be well to provide a good dust bath for chickens, it can not be depended upon for louse and mite control. It is far better to eradicate the pests completely. The main difficulty about depending upon dust baths for lice is that some fowls seldom dust themselves and those that dust freely never free themselves completely. The dust bath should be kept under cover, preferably outside the chicken house, and may consist of fine road dust with coal ashes added.

A WAY TO AVOID POULTRY PESTS

It is possible for a prospective poultryman to avoid having to contend with most poultry parasites by selecting a site that is fairly well isolated from other poultry. He should first securely fence the site and construct new buildings and runs. He should start with incubator chickens hatched on the premises and never bring any fowls onto the farm. Second-hand crates should not be brought onto the farm unless carefully disinfected beforehand. The possibility of insects being carried from infested quarters on clothing, wagons, etc., should be kept in mind, as well as the possibility of sparrows transporting them.

